

Skinner's Vision Realized: AI and the Future of Education

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Abstract

In the mid-20th century, B.F. Skinner proposed competency-based education (CBE), emphasizing mastery, individualization, and the elimination of punitive grading, claiming 95% or more of students could achieve high competency with proper instruction (Skinner, 1968, p. 64). Limited by 1950s technology, Skinner's Teaching Machines could not fully realize this vision. Today, artificial intelligence (AI) platforms, such as Alpha School's adaptive tutors, fulfill Skinner's ideas, achieving top 1–2% test scores and high student engagement (Smith, 2025). This paper explores Skinner's CBE framework, its AI-driven evolution, and resistance to grading reform, hypothesizing that grades serve as a social control mechanism (Foucault, 1977). A case study of Alpha School highlights its implementation, outcomes, and transparency challenges, while a comparison with project-based learning (PBL) examines High Tech High and Montessori schools, revealing complementary strengths (Lillard et al., 2017). We propose hybrid models blending AI-driven CBE and PBL to balance academic rigor and creativity, addressing equity, socialization, and scalability. This study offers policymakers a framework for scaling AI-driven education equitably (Tavener, 2019; Timotheou et al., 2023).

Introduction

In 1954, B.F. Skinner, a pioneer of behavioral psychology, published *The Science of Learning and the Art of Teaching*, critiquing traditional education's reliance on aversive control and proposing a scientific alternative: Teaching Machines that deliver personalized, mastery-based instruction through positive reinforcement (Skinner, 1954). His later work, *The Technology of Teaching* (1968), formalized competency-based education (CBE), claiming that 95% or more of students could achieve high competency levels with properly designed systems, replacing punitive grades with objective transcripts (Skinner, 1968, p. 64). Skinner's vision, limited by 1950s technology, anticipated modern artificial intelligence (AI), which now powers adaptive learning platforms like Alpha School's AI tutors, achieving top 1–2% test scores and high student engagement (Price, 2022; Smith, 2025). This paper explores how AI realizes Skinner's CBE, particularly through Alpha School, and examines resistance to abandoning grades, hypothesized as a social control mechanism rooted in disciplinary power (Foucault, 1977).

Despite Skinner's optimism, his ideas faced skepticism, with critics questioning the universality of his success claims and the role of cognitive factors (Kulik et al., 1980; Staddon & Cerutti, 2003). Today, AI's computational power addresses these critiques, offering dynamic personalization that Skinner's mechanical devices lacked (Chiu et al., 2024). Yet, resistance persists, as grades serve as tools for teachers, administrators, and employers to enforce compliance and gatekeep opportunities (Brookhart et al., 2016). This paper also compares CBE to project-based learning (PBL), analyzing case studies from Alpha School, High Tech High, and Montessori schools to

propose hybrid models that balance academic mastery and creativity (Condliffe et al., 2017; Tavenner, 2019). By tracing Skinner’s legacy through AI-driven education, we address equity, socialization, and scaling challenges, offering a roadmap for transformative reform (Timotheou et al., 2023).

Skinner’s Competency-Based Education

B.F. Skinner’s competency-based education (CBE), articulated in *The Science of Learning and the Art of Teaching* (1954) and *The Technology of Teaching* (1968), proposed a scientific approach to education grounded in behavioral psychology. In 1954, Skinner critiqued traditional classrooms for their reliance on aversive control (e.g., punishment, grades) and group-paced instruction, which failed to address individual differences (Skinner, 1954, p. 86). He introduced Teaching Machines, mechanical devices presenting material in small, sequential steps with immediate feedback, enabling self-paced mastery (Skinner, 1954, p. 90). By 1968, Skinner formalized CBE, emphasizing clearly defined competencies, mastery-based progression, and the elimination of grades, claiming that “95% or more of students” could achieve high competency with proper design (Skinner, 1968, p. 64).

Skinner’s approach rested on operant conditioning, where positive reinforcement (e.g., confirming correct answers) strengthens learning, while negative reinforcement (e.g., removing confusion) sustains engagement (Skinner, 1954, p. 94). For example, a student solving a math problem receives instant feedback, reinforcing the skill, a mechanism later mirrored by AI tutors (Chiu et al., 2024). Skinner argued that grades were punitive, often reflecting effort or behavior rather than mastery, and proposed objective competency transcripts to document skills transparently (Skinner, 1968, p. 112). This vision aimed to democratize education, attributing failures to systemic flaws, not student ability (Skinner, 1968, p. 23).

Critics questioned Skinner’s optimism. Kulik et al. (1980) found programmed instruction improved outcomes but didn’t universally achieve 95% success, citing variability in motivation and design (Kulik et al., 1980, p. 58). Staddon and Cerutti (2003) argued Skinner overemphasized reinforcement, neglecting cognitive factors like curiosity (Staddon & Cerutti, 2003, p. 130). These critiques highlight the technological limitations of Skinner’s era, which lacked the adaptability of modern AI. Today, platforms like Alpha School validate Skinner’s claims, achieving near-universal success through dynamic personalization, suggesting his vision was prescient, constrained only by 1950s infrastructure (Smith, 2025).

AI as Skinner’s Successor

Artificial intelligence (AI) transforms Skinner’s CBE into a scalable, adaptive reality, surpassing his Teaching Machines with advanced computational power. Alpha School’s AI tutors, for instance, deliver personalized instruction, adjusting content to each student’s skill level and pace, achieving outcomes Skinner could only envision (Price, 2022; Skinner, 1954). Unlike Skinner’s linear programs, AI employs algorithms like Bayesian knowledge tracing to analyze performance data,

tailoring lessons in real-time (Chiu et al., 2024). For example, a struggling student receives simpler problems with visual aids, while an advanced learner accesses challenging material, ensuring mastery without frustration (Forbes, 2025).

AI's technological specifics enhance Skinner's reinforcement principles. Adaptive platforms provide instant, detailed feedback, explaining errors and suggesting strategies, as seen in Alpha's tutors, which mirror Skinner's emphasis on immediate reinforcement (Price, 2022; Skinner, 1968, p. 64). Gamified elements and virtual historical figures (e.g., Einstein for math) boost engagement, fulfilling Skinner's goal of rewarding learning (Baron, 2024; Skinner, 1954, p. 90). Cloud-based systems enable scalability, delivering instruction globally at low marginal cost, unlike Skinner's costly machines. Alpha's expansion to Brownsville and charter models like Unbound Academy demonstrates this potential, serving diverse populations at \$10,000–\$50,000 annually (Price, 2025; Smith, 2025).

Limitations persist, however. AI's reliance on devices and internet access poses equity challenges, particularly in underserved areas, echoing Skinner's cost barriers (Timotheou et al., 2023). Overemphasis on individual instruction may reduce peer interaction, as critics note (Anonymous, 2023). Hybrid models, blending AI with human facilitation (e.g., Alpha's guides), mitigate these issues, aligning with Skinner's view of teachers as mentors (Skinner, 1968, p. 23). AI's ability to process vast datasets and deliver conversational, multimedia content realizes Skinner's vision, offering a scalable solution to systemic inefficiencies (Chiu et al., 2024).

Resistance to CBE: Grading as Social Control

Skinner's CBE, by replacing grades with objective competency transcripts, challenges the traditional grading system, which we hypothesize serves as a social control mechanism (Foucault, 1977). Grades enable teachers to enforce compliance, administrators to rank schools, and employers to gatekeep opportunities, and their disruption by CBE prompts resistance (Brookhart et al., 2016). This section supports this hypothesis, drawing on recent studies and Foucault's disciplinary framework, while addressing counterarguments.

Grades function as a disciplinary technology, normalizing students into hierarchical roles (e.g., "A" vs. "F") to prepare them for societal stratification, as Foucault describes (Foucault, 1977, p. 184). Schinske and Tanner (2021) argue that grades perpetuate inequities, serving as a "sorting mechanism" that teachers use to control behavior (e.g., rewarding participation) (Schinske & Tanner, 2021, p. 112). Brookhart et al. (2016) found teachers resist grading reforms, valuing grades for classroom management, while Feldman (2020) notes administrators prefer grades' simplicity for accountability (e.g., GPAs) (Brookhart et al., 2016, p. 820; Feldman, 2020, p. 25). Employers rely on grades as quick signals of ability, resisting competency transcripts' complexity (Bills, 2003, p. 445). Walkerdine (2021) extends Foucault's lens, framing grades as tools for class-based control, which CBE's student-centered assessments threaten (Walkerdine, 2021, p. 65).

Counterarguments suggest resistance stems from logistical rather than control motives. Evans and Englewood (2019) highlight CBE's complexity (e.g., redesigning curricula) as a barrier, while Pane et al. (2017) note cultural inertia among parents favoring familiar grades (Evans & Englewood, 2019, p. 204; Pane et al., 2017, p. 32). However, these are secondary to grades' disciplinary role, as stakeholders' reliance on sorting and authority persists (Foucault, 1977). Alpha's success, avoiding grades, shows cultural shifts are possible, but resistance from teachers and policymakers, as seen in Texas critiques, underscores the control hypothesis (Anonymous, 2023; Price, 2025).

Case Study: Alpha School's AI Implementation

Alpha School, a private K–12 institution founded in 2014 by MacKenzie Price in Austin, Texas, exemplifies the modern realization of B.F. Skinner's competency-based education (CBE) through its innovative use of artificial intelligence (AI) tutors. Operating in Austin, Brownsville, and Miami, with plans for seven new campuses by Fall 2025, Alpha employs a "2 Hour Learning" model where students engage with adaptive AI apps for two hours daily to master core subjects (mathematics, reading, science, social studies) aligned with Common Core standards (Price, 2022; Smith, 2025). The remaining school day focuses on life skills workshops (e.g., public speaking, robotics, financial literacy), facilitated by "guides" who provide motivational support rather than traditional instruction, echoing Skinner's vision of teachers as mentors (Price, 2025; Skinner, 1968, p. 23). This case study explores Alpha's implementation, student experiences, technological framework, outcomes, and critiques, situating it as a 21st-century evolution of Skinner's Teaching Machines.

Alpha's AI tutors deliver personalized, mastery-based instruction, adapting content to each student's skill level, pace, and interests, far surpassing the linear programming of Skinner's 1950s devices (Skinner, 1954, p. 90). For example, a 7-year-old reading at an eighth-grade level receives age-appropriate material, often enhanced by gamified elements or videos featuring historical figures like Einstein, which foster engagement through positive reinforcement (Baron, 2024; Price, 2022). The AI employs algorithms, likely Bayesian knowledge tracing, to assess conceptual gaps and provide real-time feedback, explaining why answers are correct or incorrect—a direct application of Skinner's emphasis on immediate reinforcement (Chiu et al., 2024; Skinner, 1968, p. 64). While technical details are scarce, Alpha's platform resembles advanced systems like Carnegie Learning's MATHia, tracking progress to ensure mastery before advancement (Forbes, 2025). This precision enables students to achieve academic goals in two hours, freeing time for passion projects and holistic development, as Skinner envisioned for efficient learning (Skinner, 1954, p. 92).

Student experiences highlight the model's motivational impact, aligning with Skinner's goal of fostering a love for learning (Skinner, 1968, p. 112). Elle Kristine, a junior, credits Alpha's homework-free structure for reducing stress and enabling her to develop an AI dating coach featured in *The Wall Street Journal* (Smith, 2025). Fifth-grader Byron praises the AI's detailed

feedback, which clarifies mistakes unlike traditional teachers' vague responses, reinforcing understanding (KVUE, 2023). Kindergartner Sarah Schipper, age 6, enjoys collaborative logic games, while second-grader Marshall, age 7, accesses advanced curricula, boosting confidence (DigiAlps, 2025; Smith, 2025). Parent Scott Jensen, initially skeptical, reports success for his children, who struggled in public schools during COVID-19 (Fox 7 Austin, 2024). These testimonials reflect the autonomy and joy Skinner sought, mirroring the engaging, nonjudgmental interactions users experience with AI platforms like Grok (Waford, 2025). However, a Reddit parent noted their son's anxiety from Alpha's fast-paced model, suggesting it may not suit all learners, particularly those needing structure (Anonymous, 2023).

Alpha's outcomes are impressive but require critical scrutiny. Students consistently rank in the top 1–2% on Northwest Evaluation Association's Measures of Academic Progress (MAP) assessments, with reported SAT averages of 1410 and graduates attending elite universities (e.g., Stanford, Northwestern) (Price, 2022; Smith, 2025). Price claims students learn "twice as fast" as peers, condensing a full day's academics into two hours, validated by examples like a 7-year-old accessing fourth-grade material (Price, 2025; DigiAlps, 2025). These results support Skinner's assertion that 95% or more of students can achieve high competency with proper instruction (Skinner, 1968, p. 64). However, the absence of peer-reviewed studies or public white papers raises transparency concerns, as outcomes rely on self-reported data and media reports, potentially skewed by selection bias (e.g., motivated families opting into Alpha) (Anonymous, 2023; Smith, 2025). Alpha's limited public data may prioritize proprietary AI systems and student privacy, given small cohorts (~150 students in Austin) and competitive expansion plans (Bennett, 2024; Fox 7 Austin, 2024). Nevertheless, the lack of randomized controlled trials (RCTs) limits generalizability, particularly for diverse or less motivated populations, underscoring the need for rigorous research as Skinner advocated (Skinner, 1968, p. 23).

Critiques of Alpha's model highlight challenges to scalability and inclusivity. Reddit discussions question whether two-hour AI sessions foster sufficient socialization or critical thinking, arguing that traditional schools offer serendipitous learning through peer and teacher interactions (Different-Froyo9497, 2025). Alpha counters this with life skills workshops, but concerns persist about over-reliance on individual AI instruction (Price, 2022). High tuition (\$10,000–\$50,000 annually, despite 75% financial aid in Austin) raises equity barriers, though subsidized campuses (e.g., Brownsville) and charters like Unbound Academy aim to broaden access (Baron, 2024; Price, 2025). Texas teachers express skepticism, citing public school constraints and AI's inability to replicate human nuance, potentially reflecting resistance to CBE's disruption of grading's control, as hypothesized (Anonymous, 2023). Forbes notes that Alpha suits self-motivated students but may struggle with those requiring structured support, echoing the Reddit parent's concerns (Forbes, 2025). These critiques suggest that while Alpha fulfills Skinner's vision for personalized, efficient learning, its scalability requires addressing socialization, equity, and diverse learner needs, potentially through hybrid models integrating project-based learning (Condliffe et al., 2017).

Alpha School's AI-driven CBE demonstrates the transformative potential of Skinner's ideas, achieving exceptional outcomes and student engagement through advanced technology. Its transparency limitations and critiques highlight areas for growth, particularly as it scales. Future RCTs and partnerships with researchers could validate its efficacy, ensuring alignment with Skinner's scientific approach and broadening its impact on education (Skinner, 1954; Timotheou et al., 2023).

CBE vs. Project-Based Learning

While Alpha School's AI-driven CBE achieves unparalleled academic precision, project-based learning (PBL), as practiced by High Tech High and Montessori schools, offers a complementary approach emphasizing creativity and collaboration. This section compares CBE and PBL, focusing on standardized test scores and evaluation methods, and proposes hybrid models to balance their strengths.

CBE, rooted in Skinner's behaviorism, ensures mastery of discrete competencies through structured, individualized instruction (Skinner, 1968, p. 64). Alpha's AI tutors deliver Common Core-aligned lessons, achieving top 1–2% MAP scores through real-time feedback and mastery-based progression (Smith, 2025). PBL, grounded in Dewey's constructivism, fosters student-driven projects integrating multiple skills, prioritizing experiential learning (Dewey, 1938). High Tech High and Montessori schools exemplify PBL, with varied but less dominant test scores and holistic evaluations (Lillard et al., 2017).

High Tech High: This San Diego charter network uses PBL, with students creating projects like documentaries or community solutions (High Tech High, 2024). SBAC data shows 62% ELA and 55% math proficiency, surpassing California averages (47% ELA, 33% math) but trailing Alpha's 99th percentile MAP scores (California Department of Education, 2024; Smith, 2025). MAP scores average 60th–70th percentile, reflecting solid performance but less focus on test prep (Huberman et al., 2022, p. 45). HTH evaluates progress through portfolios, exhibitions, and rubrics, assessing skills like problem-solving and teamwork, not just cognitive mastery (Condliffe et al., 2017, p. 18). This less cognitive focus aligns with Dewey but contrasts with Skinner's precision (Dewey, 1938; Skinner, 1954).

Montessori Schools: Montessori's PBL-like approach uses hands-on materials and self-directed learning in mixed-age classrooms (Lillard, 2017). MAP scores range from 50th–60th percentile (public) to 70th–80th percentile (private), with SBAC data showing 50% ELA and 45% math proficiency, far below Alpha (Lillard et al., 2017, p. 315; Montessori, 2024). Evaluations include narrative reports and observation logs, tracking developmental milestones (e.g., independence) alongside academics, prioritizing holistic growth over cognitive rigor (Lillard et al., 2017, p. 302). This contrasts with Alpha's AI-driven competency tracking (Price, 2022).

Comparison: Alpha's CBE excels in cognitive outcomes due to its structured, AI-supported approach, while HTH and Montessori foster creativity and social skills, yielding lower test scores

but strong non-cognitive outcomes (e.g., 95% HTH college acceptance, Montessori executive function gains) (High Tech High, 2024; Lillard et al., 2017). Skinner would favor CBE's precision but appreciate PBL's motivation if competencies were clear (Skinner, 1968). AI enhances CBE's scalability, while PBL uses AI for resource curation, suggesting complementary roles (Chiu et al., 2024).

Hybrid Models: Summit Public Schools blend AI-driven CBE for core skills with PBL projects, ensuring academic rigor and applied learning (Tavener, 2019). For example, students master math via AI, then design a budget for a mock business, balancing Skinner's and Dewey's principles. Such hybrids could address Alpha's socialization critiques and PBL's inconsistency, leveraging AI for personalization and PBL for collaboration (Condliffe et al., 2017).

Implications and Future Directions

Alpha School's success validates Skinner's CBE, but scaling AI-driven models requires addressing equity, socialization, and resistance. High tuition (\$10,000–\$50,000) limits access, though Brownsville's subsidized campus and charters show promise (Price, 2025). Public-private partnerships could bridge infrastructure gaps, ensuring equitable access (Timotheou et al., 2023). Socialization concerns, raised by Alpha critics, can be mitigated by integrating PBL's collaborative projects, as seen in HTH and Montessori (Condliffe et al., 2017; Different-Froyo9497, 2025). Resistance to CBE, tied to grading's control, requires pilot programs and teacher training to shift mindsets, as Sanusi et al. (2024) suggest (Sanusi et al., 2024, p. 94).

Future research, including RCTs comparing Alpha, HTH, and Montessori, is critical to validate long-term efficacy and inclusivity, fulfilling Skinner's scientific vision (Skinner, 1968). Hybrid models, leveraging AI's precision and PBL's creativity, offer a path to transform education, unlocking human potential as Skinner envisioned (Skinner, 1954; Tavener, 2019).

Conclusion

Skinner's competency-based education, constrained by 1950s technology, finds new life in AI-driven platforms like Alpha School, which achieve exceptional outcomes through personalized, mastery-based instruction (Smith, 2025). Resistance to grading reform reflects grades' role as social control, yet Alpha's success suggests cultural shifts are possible (Foucault, 1977; Schinske & Tanner, 2021). Comparing CBE with PBL reveals complementary strengths, with hybrids offering a balanced future (Tavener, 2019). Educators and researchers should pilot AI-PBL hybrids to realize Skinner's equitable vision, transforming education into a joyful, equitable pursuit of human potential (Skinner, 1968; Timotheou et al., 2023).

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